

### REMARKS

Claims 23-30 are pending. Claim 23 is amended. The Applicants respectfully request entry of the amendment which is believed to place the application in better condition for allowance or, alternatively, appeal. Support for the amendment can be found at, for example, Table 2-1 and at the paragraph spanning the bottom of page 15 and the top of page 16 of the originally filed application. Claims 23-30 are rejected.

At the outset, the Applicants wish to thank the Examiner for the helpful interview of October 15, 2009 in which the rejections were discussed. This Supplemental Response is consistent with the discussion during the interview and the Examiner's helpful guidance.

Claims 23-30 are rejected as obvious under 35 USC §103 over the combination of US '105, US '688 and US '358. The Applicants respectfully submit that Claims 23-30 are not obvious over the combination of US '105, US '688 and US '358. Reasons are set forth below.

The Advisory Action appears to deny the unexpected grain refining effect produced by the claimed methods. These unexpected results on austenite grain size are shown in revised Reference Fig. 1 (courtesy copy enclosed). These unexpected results are produced by the Mo content and hardening temperature used in the claimed methods. Thus, regardless of whether compositions containing this grain size might be produced with different methods does not seem sufficient to deny that the claimed methods are non-obvious because they produce unexpected results. Instead, it seems as if the method claims are being confused with a composition claim. It also seems that the rejection may be based on a misinterpretation of the requirement in the claims that "the prior austenite grain size of the hardened layer is 8  $\mu\text{m}$  or less" which is a separate requirement for the compositions disclosed in US '358. This separate requirement is distinct from the steps of the claimed methods relating to the Mo content and the hardening temperature used to produce an induction hardened member.

The unexpected grain refining effect achieved by the claimed methods is shown as <A> in the attached revised Reference Fig. 1 and results from the steps of the claimed methods requiring that "[the steel contains] Mo: 0.05 - 0.6%" and that the "heating temperature of the final induction hardening is 800-950°C[.]". The Applicants have unexpectedly found, when the Mo content and hardening temperature is limited in the particular ranges recited in the claimed methods, the austenite grain size obtained is much smaller than the size level predicted from the research of adjacent ranges

which is a new function and an unexpected result. *See* revised Reference Fig. 1. The solicited claims are method claims. Such new functions and expected results demonstrate the claimed methods are non-obvious regardless of any absolute grain size value achieved in the steel of US '358.

As an additional matter, the Applicants respectfully submit that the portion of US '358 referred to in the Advisory Action only discloses that a steel of not less than GSN 8 is advantageous for the properties of the steel. *See* US '358 at column 6, lines 26-34. Importantly, US '358 does not suggest every grain size not less than GSN 8 can be achieved using the disclosure and does not provide methods for accomplishing this. As the Applicants already previously demonstrated, a GSN of 8.9 (about 18  $\mu\text{m}$ ) is the smallest grain size actually achieved in US '358. *See* US '358 at column 8, lines 23-26. Such disclosure might be relevant to compositions claims, but is irrelevant to the solicited methods claims. This is because new methods for making a composition can be non-obvious even if the composition was previously known. Importantly, US '358 and the other cited references do not appear to teach methods for producing compositions with a GSN greater than 8.9 (about 18  $\mu\text{m}$ ) and cannot render the claimed methods, which achieve an “austenite grain size of...8  $\mu\text{m}$  or less[,]” obvious. Thus, it is apparent that US '358 and the other cited references fail to clearly teach all the elements of the claimed methods.

The Applicants also respectfully submit the requirement in the claimed methods for an austenite grain size of “8  $\mu\text{m}$  or less” itself also produces an unexpected result. This is shown in Reference Fig. 2 (courtesy copy enclosed). Reference Fig. 2 is a plot of every inventive example, and comparative example of deviated grain size, in the Tables 2-1 to 2-3 in the Applicants’ specification. Sample numbers are noted in the figure. Actual grain size in US '358 is also disclosed in the figure.

As seen in Reference Fig. 2, the torsional fatigue strength with a grain size of 12  $\mu\text{m}$  or less is greatly improved and is much higher than expected relative to the result obtained with a grain size of about 13  $\mu\text{m}$  or larger. *See* Reference Fig. 2 at line <B>. Such unexpected results, again, show that the claimed methods are non-obvious. In fact, these unexpected results rebut the argument that the claimed methods are obvious merely because US '358 discloses the overlapping grain size, without disclosing methods to achieve the grain sizes recited in the claimed methods.

Altogether, it is apparent the claimed methods are not obvious over the cited references and that the rejection fails to establish *prima facie* obviousness.

Most importantly, amended Claims 23-30 now recite that “the prior austenite grain size of the hardened layer is 8  $\mu\text{m}$  or less through the thickness of the hardened layer.” This means that claimed methods are not obvious because an induction hardened member produced by these methods unexpectedly has an austenite grain size of “8  $\mu\text{m}$  or less[.]” As discussed above, these unexpected results are clearly shown in Fig. 1. Thus, the Applicants respectfully submit that amended Claims 23-30 are clearly directed to methods for producing induction hardened members with these unexpected properties and are not obvious over the cited references for this reason. Additionally, the Applicants note this is consistent with the helpful discussion during the interview.

The Applicants respectfully request withdrawal of the obviousness rejections of Claims 23-30.

In light of the foregoing, the Applicants respectfully submit that the entire application is now in condition for allowance, which is respectfully requested.

Respectfully submitted,



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